

**Interim Runway Visual Range (RVR)  
Automated Surface Observing  
System (ASOS) Interface Operational  
Test and Evaluation (OT&E)  
Regression Test #2 Report**

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August 1998

DOT/FAA/CT-TN98/7

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16. Abstract  This report discusses results of a regression test performed on the Interim Runway Visual Range (RVR)/Automated Surface Observing System (ASOS) Interface. Testing was conducted from September 29, 1997, to October 13, 1997, at Memphis International Airport. This was the second regression test performed on the interface following modifications to the RVR-ASOS executable, which operates on the Hewlett Packard Palmtop Personal Computer (HP Palmtop PC).  Regression Test #2 was primarily intended to determine if the HP Palmtop RVR-ASOS executable would accurately calculate Long-Line RVR data during various configurations and combinations of New Generation RVR data. Proper ingestion and Display of Long-Line RVR products were also confirmed on ASOS display screens.  Test results indicate the custom HP Palmtop software accurately calculated Long-Line RVR readings during the conducted test scenarios. Proper ingestion and display of Long-Line RVR data were confirmed on the ASOS. Results also indicate several problems found during previous OT&E tests were corrected from software modifications to the HP Palmtop and the ASOS.  These results suggest the Interim RVR/ASOS Interface is suitable for field deployment and usage. Despite the performance improvements observed, four problems were documented during testing. Three problems related to operation of the ASOS and one concerned operation of the HP Palmtop. Since it is anticipated the observed problems will not impact normal operation of the Interim RVR/ASOS Interface or ASOS, ACT-320 recommends deployment at locations designated by the Federal Aviation Administration (FAA) and the National Weather Service (NWS).					
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## EXECUTIVE SUMMARY

Performance of the Interim Runway Visual Range (RVR)/Automated Surface Observing System (ASOS) was evaluated during regression tests held from September 29, 1997, to October 13, 1997, in Memphis, TN. Personnel involved in the test included representatives from the Federal Aviation Administration (FAA) William J. Hughes Technical Center and the National Weather Service (NWS). This was the second regression test performed on the interface following modifications to the RVR-ASOS executable operating on the interface's primary component, the Hewlett Packard Palmtop personal computer (HP Palmtop PC).

Testing was primarily intended to verify that the RVR-ASOS executable would accurately calculate Long-Line RVR data, i.e., RVR reading recalculated at light setting 5, during various combinations and configurations of New Generation RVR data output. The proper display of RVR products was to be verified on ASOS display screens. Testing was also intended to determine if software functions such as the watch-dog timer and diagnostic messages performed in accordance with the intended design.

The test session was classified as Regression Operational Test and Evaluation (OT&E) and consisted of executing procedures as described in the New Generation RVR Automated Surface Observing System Operational Test and Evaluation Test Procedure document, dated September 24, 1997.

Results indicate the software accurately calculated Long-Line RVR products during all test scenarios conducted. Proper ingestion and display of Long-Line RVR data were confirmed on the ASOS. Results also indicate several problems identified during the previous regression test were corrected as a result of modifications to HP Palmtop software and the ASOS.

These results suggest the Interim RVR/ASOS Interface is suitable for field deployment. Despite the observed performance improvements, four problems were noted during testing. Three problems related to the ASOS operation and one was attributed to the operation of the HP Palmtop. Since it is anticipated that the observed problems should not impact normal operation of the Interim RVR/ASOS Interface or ASOS, ACT-320 recommends deployment of the interface at locations designated by the FAA and the NWS.

Although deployment is recommended, additional modification to the Interim RVR/ASOS Interface and ASOS should also be performed in the future to correct the identified problems.

## 1. BACKGROUND.

The Interim Runway Visual Range (RVR)/Automated Surface Observing System (ASOS) Interface initially completed and passed Operational Test and Evaluation (OT&E) Regression tests conducted from January 21, 1997, to January 23, 1997, at Memphis International Airport (MEM). During this session, problems observed during initial OT&E in October of 1996 were shown to be corrected as a result of software modifications to the Hewlett Packard Palmtop personal computer (HP Palmtop PC; primary component of the Interim RVR/ASOS Interface), and the ASOS. Elimination of these problems and the observance of no new problems resulted in a deployment recommendation from ACT-320. Subsequently, installations were completed at San Francisco International Airport (SFO) and Los Angeles International Airport (LAX). Operation of the Interim RVR/ASOS Interface commenced in August of 1997.

Although performance of the Interim RVR/ASOS Interface at SFO and LAX initially appeared to be in accordance with its design, operational discrepancies were noted on ASOS after approximately 1 week. Analysis efforts indicated a problem existed with the RVR-ASOS executable which processes New Generation RVR raw data and transmits RVR products prepared for Long-Line dissemination on the ASOS. The software problem led to erroneous HP Palmtop RVR product calculations and the display of erroneous Long-Line RVR readings on the ASOS.

As part of an effort to correct the HP Palmtop software problem, ACT-320 representatives performed an analysis of the RVR-ASOS source code. Analysis results indicated the existence of two problems:

- a. RVR product functions could not properly account for calculated RVR products greater than 32,768 feet; and
- b. The time stamp included with HP Palmtop diagnostic messages were corrupted.

For the RVR product calculation problem, investigation of a variable definition statement revealed an RVR product value defined as an "Integer" type. Since the maximum value for Integer variables is 32,678, a conflict could occur when RVR products in excess of 32,678 feet were computed<sup>1</sup>. To correct this problem, the variable containing the RVR product was redefined as type--"Long" instead of "Integer."

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<sup>1</sup> It was believed natural weather conditions during previous OT&E test sessions did not enable raw RVR product calculations in excess of 32,678 feet. Therefore, although the problem existed, it was undetected.

For the error in the diagnostic time stamp, examination of the source code revealed a string variable missing from an existing screen print statement. The string variable was added as part of the screen print function to correct this problem.

After modifying portions of the RVR-ASOS source code, ACT-320 personnel conducted developmental tests at the Federal Aviation Administration (FAA) William J. Hughes Technical Center to verify proper software performance. Completion of these tests resulted in no further performance discrepancies, and a formal regression test was scheduled.

### 1.1 PURPOSE.

The purpose of this report is to discuss results of Regression OT&E activities performed on the Interim RVR/ASOS Interface from September 29, 1997, to October 13, 1997, at MEM.

### 1.2 SCOPE.

This report discusses the initial results of Regression Test #2 for the Interim RVR/ASOS Interface. The status of problems reported in the previous Regression test are discussed as well as new problems noted during this test.

## 2. REFERENCE DOCUMENTS.

This document was developed in accordance with Acquisition Management System Test and Evaluation Guidelines, dated July 18, 1997.

## 3. SYSTEM DESCRIPTION.

This section provides a mission review summary for the New Generation RVR and a brief description of the test system configuration for the Interim RVR/ASOS Interface and ASOS.

### 3.1 MISSION REVIEW.

The New Generation RVR system is designed to provide measurement of runway visibility at specific points along a precision runway. The system supports instrument landings during Category I, II, IIIa/b visibility conditions as defined in specification FAA-E-2772. To provide RVR data, the system determines the following parameters:

- a. Ambient light intensity,
- b. Atmospheric scattering coefficient, and
- c. Runway centerline/edge light intensity.



The system processes this data to output distances a pilot could expect to see along the departure or approach path of the runway. The New Generation RVR system is designed to decrease the maintenance load and installation difficulties associated with predecessor runway visual range systems. Future expansion capabilities will be easier and less costly.

### 3.1.1 Interim RVR/ASOS Interface.

Development and implementation of the Interim RVR/ASOS Interface is intended to provide immediate service for Long-Line RVR reporting, i.e., 10-minute average RVR reading at light setting 5. Since all Interim RVR/ASOS Interface equipment functions external to the New Generation RVR, its use requires no physical modification to the New Generation RVR. Minimum requirements for use of the interface include a commissioned New Generation RVR system utilizing software version National Deployment Baseline +1 (NDB+1), and an accepted<sup>2</sup> ASOS using software version 2.49.

The Interim RVR/ASOS Interface primary purpose is to convert raw New Generation RVR data to Long-Line reporting format and transfer the data to ASOS. As the data is received, the ASOS reports the Long-Line RVR readings as part of the Aviation Routine Weather Report (METAR) message.

### 3.2 TEST SYSTEM CONFIGURATION.

The Interim RVR/ASOS Interface consists of a HP 200 LX Palmtop computer with an RVR-ASOS executable program designed to facilitate ASOS data conversion and transmission. The HP Palmtop utilizes DOS version 5.0, internal Random Access Memory (RAM) and data storage, and a 5-megabyte (MB) Personal Computer Memory Card International Association (PCMCIA) memory card which functions similar to a standard PC floppy disk.

Through a split RS-232 serial cable, the HP Palmtop was connected to the New Generation RVR Data Processing Unit's (DPU) External User port, and to an RS-232 to EIA-530 signal level converter. The split cable permitted the HP Palmtop to receive raw RVR data and transmit ASOS Application Data Units (ADUs) from the same serial port. The RS-232 to EIA-530 level converter enabled HP Palmtop outputs to be compatible with an RVR serial port located on the ASOS Acquisition Control Unit (ACU).

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<sup>2</sup> Stage or status of a NWS system before it is officially commissioned. There are five stages of which the fifth is the commissioned stage. The MEM ASOS was a level 4 indicating acceptance but not commissioning.

In addition to the HP Palmtop PC, the Test System Configuration consisted of an operational New Generation RVR configured with NDB+1 software and the ASOS configured with software version 2.49.

### 3.3 INTERFACES.

The Interim RVR/ASOS Interface utilizes the New Generation RVR External User Interface to receive unprocessed RVR data. After processing, the HP Palmtop RVR-ASOS executable enables one-way transmission of ADUs to ASOS of the format shown in figure 3.3-1. The ADU was transferred to the ASOS ACU at a rate of twice per minute.

Time Stamp	Runway ID	Runway Sub ID	RVR Product
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FIGURE 3.3-1. RVR-ASOS APPLICATION DATA UNIT

The Data Processing Unit Maintenance Data Terminal (MDT) interface was used throughout testing to monitor and control New Generation RVR parameters and functions. A local ASOS ACU interface permitted use of an Operator Information Display (OID) to monitor all RVR related display screens on ASOS. The OID also permitted direct control of the ASOS throughout testing.

## 4. REGRESSION TEST #2 DESCRIPTION.

This section briefly discusses the following topics: test schedule and location, participants, test objectives and criteria, test setup and conduct, and data collection and analysis.

### 4.1 TEST SCHEDULE AND LOCATION.

Regression Test #2 was scheduled to be conducted at MEM during the week of September 29, 1997. Test exercises requiring on-site participants were completed from September 29, 1997 to October 4, 1997. Additional tests were also performed which did not require test team participants on-site. These tests were monitored remotely and completed on October 13, 1997.

### 4.2 PARTICIPANTS.

Personnel from the FAA Technical Center, the NWS, and MEM conducted and performed the planned testing. The responsibilities of each organization involved in testing are listed in the following subparagraphs.

#### 4.2.1 FAA William J. Hughes Technical Center.

FAA William J. Hughes Technical Center (Technical Center) personnel functioned as Test Director and Test Engineers during the test. These representatives performed the installation of Interim RVR/ASOS Interface components and test equipment required for testing. Technical Center representatives also executed tests and conducted on-site evaluation and analysis required on the New Generation RVR, ASOS, and Interim RVR/ASOS Interface.

#### 4.2.2 National Weather Service (NWS).

NWS personnel executed tests and conducted on-site evaluation and analysis of ASOS and Interim RVR/ASOS Interface performance.

#### 4.2.3 Memphis International Airport (MEM).

MEM personnel provided access to New Generation RVR and ASOS equipment facilities. MEM personnel also secured and provided additional printers, monitors, tables, etc., needed for testing.

#### 4.3 OVERALL TEST OBJECTIVES AND CRITERIA.

The primary objective of Regression Test #2 was to determine if the RVR calculation discrepancies encountered during operational and test conditions were corrected as a result of modifications to the HP Palmtop RVR-ASOS executable. Additional objectives included verifying proper performance of other HP Palmtop software functions such as:

- a. Watch-dog Timer operation,
- b. Adjustments to New Generation RVR configuration change, and
- c. Operator diagnostic messages.

Regression testing was also intended to verify proper data display on the ASOS.

#### 4.4 REGRESSION TEST #2 SETUP AND CONDUCT.

Four test categories were performed on the Interim RVR/ASOS Interface. Each test category and the corresponding setup and conduct is provided in the following subparagraphs. The categories are identified as follows:

- a. Simulated RVR to ASOS Test,
- b. Operational Procedure Test,
- c. Data Communication Failure Test, and
- d. Extended Operation and Evaluation Test.

#### 4.4.1 Simulated RVR to ASOS Test.

The Simulated RVR to ASOS Test was the first test performed during Regression OT&E. This test featured use of a PC-based ASOS ADU generator which replicated Interim RVR/ASOS Interface output functionality by sending ASOS ADUs to the ASOS ACU. The ADU generator was programmed to transmit a range of RVR products, e.g., 100 feet to 6500 feet, usually with a different product transmitted each minute, and function continuously without operator intervention.

ASOS ADU generator RVR products were transmitted at the same rate, i.e., 2x/minute, as from the Interim RVR/ASOS Interface. Non-numeric and illegal RVR products such as "FFF", " ", and "(+" were also transmitted from the ADU generator. The ASOS was configured to display RVR products as they were received. The test focused on verifying whether RVR products displayed on the ASOS display matched transmitted ADU products. The ADU generator transmitted RVR products for approximately 3 hours under control of several script files. Paragraph 4.4.1.2 discusses the intent of each script file used during testing.

##### 4.4.1.1 Simulated RVR to ASOS Test Objectives.

The objective of the Simulated RVR to ASOS Test was to verify proper operation of ASOS RVR functions implemented in software version 2.49.

##### 4.4.1.2 Simulated RVR to ASOS Test Setup.

The ASOS ADU generator was connected to ASOS as shown in figure 4.4.1.2-1. ASOS was initialized with its operational software during test setup.

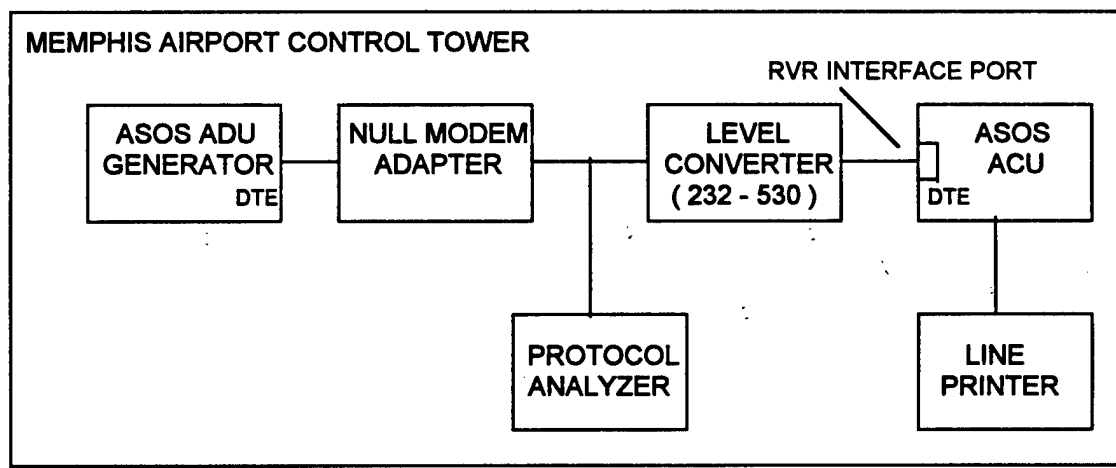


FIGURE 4.4.1.2-1. SIMULATED RVR TO ASOS TEST SETUP

#### 4.4.1.2.1 ADU Generator Script Files.

Script files identified in paragraphs 4.4.1.2.1.1 through 4.4.1.2.1.5 were used to output "canned" or preprogrammed RVR products during the Simulated RVR to ASOS Test. File contents are listed in table 1 to table 5. A brief discussion of the script file precedes each table.

For each table, the row labeled with RWYID represents the runway identifier included in each RVR product transmitted. The PROD# column identifies the order of the product transmitted. The column labeled VALUE contains the actual RVR product transmitted. The ADU generator was configured to repeat the script file output sequence immediately after transmission of the last product in the file. For example, in table 3 PROD# 1 was transmitted after PROD# 60.

##### 4.4.1.2.1.1 Rvrmsg3.dat.

Rvrmsg3.Dat was designed specifically to verify whether ASOS "specials" or detection of significant weather parameter changes, were properly generated in response to RVR product variations.

Since ASOS processing software was designed to generate an RVR special when the RVR product crossed 2400 feet (in both directions), typical RVR product values on each side of the 2400-foot threshold were included in RVRMSG3.DAT to test this function. An additional requirement for the ASOS special was that the RVR product must remain above/below the threshold for at least 10 minutes. This was accounted for in the RVRMSG3.DAT file by including 10 minutes or at least 20 RVR product readings above and below 2400 feet. FFF products were included at the end of the script file sequence to verify whether the occurrence of a series of non-numeric products would prevent proper detection and notification of an RVR weather special. To determine if an RVR special was generated when RVR readings increased past the 2400-foot threshold, the RVRMSG3.DAT file contained an RVR product sequence where a series of 2200-foot RVR readings (represented by the number 22) changed to a series of 2600-foot readings (represented by the number 26).

TABLE 1. SCRIPT FILE RVRMSG3.DAT

RWYID	02L								
PROD#	VALUE	PROD#	VALUE	PROD#	VALUE	PROD#	VALUE	PROD#	VALUE
1	22	13	22	25	26	37	26	49	FFF
2	22	14	22	26	26	38	26	50	FFF
3	22	15	22	27	26	39	26	51	FFF
4	22	16	22	28	26	40	26	52	FFF
5	22	17	22	29	26	41	FFF	53	FFF
6	22	18	22	30	26	42	FFF	54	FFF
7	22	19	22	31	26	43	FFF	55	FFF
8	22	20	22	32	26	44	FFF	56	FFF
9	22	21	26	33	26	45	FFF	57	FFF
10	22	22	26	34	26	46	FFF	58	FFF
11	22	23	26	35	26	47	FFF	59	FFF
12	22	24	26	36	26	48	FFF	60	FFF

#### 4.4.1.2.1.2 Rvrmsg4.dat.

Rvrmsg4.Dat was designed with the same general intent as Rvrmsg3.Dat, but was specifically intended to verify generation of an ASOS RVR special in response to a decrease in RVR readings through the 2400-foot threshold. As a result, the RVR product sequence contained the transition from a series of 2600-foot products to a series of 2200-foot products.

TABLE 2. SCRIPT FILE RVRMSG4.DAT

RWYID	02L								
PROD#	VALUE	PROD#	VALUE	PROD#	VALUE	PROD#	VALUE	PROD#	VALUE
1	26	13	26	25	22	37	22	49	FFF
2	26	14	26	26	22	38	22	50	FFF
3	26	15	26	27	22	39	22	51	FFF
4	26	16	26	28	22	40	22	52	FFF
5	26	17	26	29	22	41	FFF	53	FFF
6	26	18	26	30	22	42	FFF	54	FFF
7	26	19	26	31	22	43	FFF	55	FFF
8	26	20	26	32	22	44	FFF	56	FFF
9	26	21	22	33	22	45	FFF	57	FFF
10	26	22	22	34	22	46	FFF	58	FFF
11	26	23	22	35	22	47	FFF	59	FFF
12	26	24	22	36	22	48	FFF	60	FFF

#### 4.4.1.2.1.3 Rvrmsg5.dat.

Rvrmsg5.Dat was intended to verify proper ASOS reception and display of non-numeric RVR products such as " ", FFF, and 60+. Additionally, the file was configured to verify generation of an RVR special by including a transition from products below and above 2400 feet. This file was also intended to verify proper reception and display of a runway identifier, "36", without a letter designation, i.e., L, R, C.

TABLE 3. SCRIPT FILE RVRMSG5.DAT

RWYID	36						
PROD#	VALUE	PROD#	VALUE	PROD#	VALUE	PROD#	VALUE
1	10	13	16	25	FFF	37	60+
2	02	14	18	26	60+	38	60+
3	03	15	18	27	60+	39	60+
4	03	16	22	28	60+	40	
5	04	17	22	29	60+	41	
6	04	18	22	30	60+	42	
7	10	19		31	60+	43	02
8	10	20		32	60+	44	50
9	10	21		33	60+	45	50
10	14	22		34	60+	46	55
11	14	23	FFF	35	60+	47	57
12	16	23	FFF	35	60+	47	57

#### 4.4.1.2.1.4 Rvrmsg6.dat.

The Rvrmsg6.Dat file was designed to verify whether the entire range of RVR products would be properly displayed on ASOS and verify proper generation of RVR related specials. For this file, a series of RVR products different from the previous files were used. For RVR products below the 2400-foot threshold, RVRMSG6.DAT was configured to allow a different RVR product to be transmitted each minute. For products above 2400 feet, the same product was transmitted each minute until the final 2 minutes.



TABLE 4. RVRMSG6.DAT

RWYID	36L								
PROD#	VALUE	PROD#	VALUE	PROD#	VALUE	PROD#	VALUE	PROD#	VALUE
1	01	11	10	21	60+	31	60+	41	57
2	01	12	10	22	60+	32	60+	42	57
3	02	13	14	23	60+	33	60+		
4	02	14	14	24	60+	34	60+		
5	03	15	16	25	60+	35	60+		
6	03	16	16	26	60+	36	60+		
7	04	17	18	27	60+	37	60+		
8	04	18	18	28	60+	38	60+		
9	10	19	22	29	60+	39	50		
10	10	20	22	30	60+	40	50		

#### 4.4.1.2.1.5 Rvrmsg7.dat.

The Rvrmsg7.dat file was designed to verify how properly formatted, and non-numeric RVR products would be accounted for on ASOS display screens. To accomplish this, Rvrmsg7.dat contained a series of legal and typical RVR products followed by instances of non-numeric products not in accordance with the RVR-ASOS Interface Control Document (ICD).

TABLE 5. RVRMSG7.DAT

RWYID	36L								
PROD#	VALUE	PROD#	VALUE	PROD#	VALUE	PROD#	VALUE	PROD#	VALUE
1	01	7	04	13	07	19	(+	41	60+
2	01	8	04	14	07	20	(+	42	60+
3	02	9	05	15	08	21	(+		
4	02	10	05	16	08	22	(+		
5	03	11	06	17	(+	23	60+		
6	03	12	06	18	(+	24	60+		

#### 4.4.2 Operational Procedure Test.

The Operational Procedure Test consisted of two parts whereby typical and atypical operating system tasks were performed on the New Generation RVR System and ASOS. Paragraphs 4.4.2.1 and 4.4.2.2 provide further descriptions of the conducted tests.

#### 4.4.2.1 Operational Procedure Test Part 1.

Operational Procedure Test Part 1 consisted of performing a subset of system tasks on the New Generation RVR and ASOS such as restarts, maintenance, configuration, and fault diagnosis. While these system tasks were performed, proper operation of non-RVR/ASOS related components, the RVR/ASOS Interface and ASOS were monitored for performance degradation and anomalies. The following categories of system tasks were performed during OT&E:

- a. Component restart/reset. For the New Generation RVR system, each sensor type, i.e., Visibility Sensor (VS), Ambient Light Sensor (ALS), Current Loop Sensor (CLS), the DPU, and main processing units were restarted via MDT control. For ASOS, the ACU was restarted with hardware and software initialization procedures.
- b. System restart. Via the New Generation RVR MDT, system restarts were initiated for New Generation RVR hardware and software. System reinitialization was also performed on ASOS.
- c. Maintenance. The New Generation RVR system was configured for local control and sensor recalibration was performed. Additionally, MDT parameter display screens were exercised and examined for each sensor and the DPU. For ASOS, maintenance as described in the Site Technical and Software Users manual was performed.
- d. Fault diagnosis. Fault diagnostic tests were performed for each sensor and the New Generation RVR DPU. Results were examined for accuracy and completion. A related set of fault diagnosis procedures as described in the Site Technical and Software Users manual was performed on the ASOS.

#### 4.4.2.2 Operational Procedure Test Part 1 Objectives.

The objective of Operational Procedure Test Part 1 was to verify proper operation of New Generation and ASOS system tasks such as described in section 4.4.2.1. Additionally, this test was designed to confirm proper operation of the Interim RVR/ASOS Interface during execution of system tasks.

##### 4.4.2.2.1 Operational Procedure Test Part 1 Setup.

Data collection devices, test equipment, and the RVR/ASOS interface were connected as shown in figure 4.4.2.2.1-1.

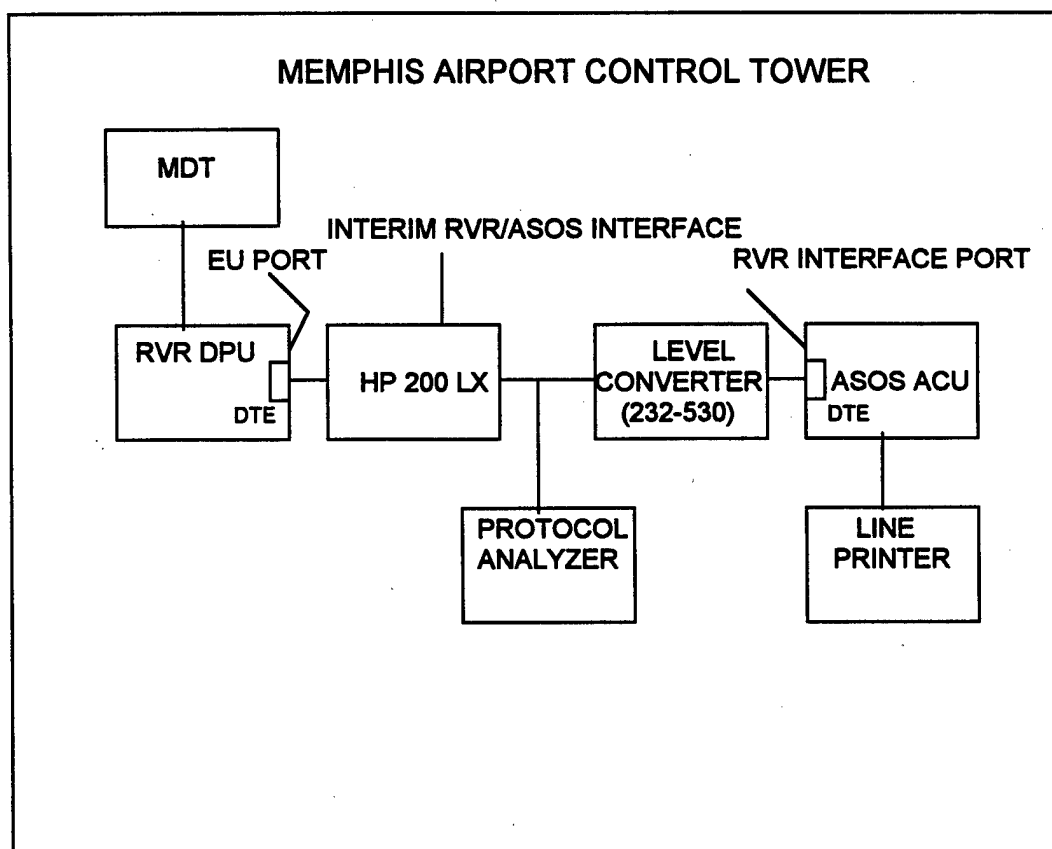


FIGURE 4.4.2.2.1-1. OPERATIONAL PROCEDURE TEST SETUP

#### 4.4.2.3 Operational Procedure Test Part 2.

Operational Procedure Test Part 2 consisted of manipulating RVR sensor measurements on the VS, ALS, and RLIM to generate various RVR products within the ASOS ADU from the Interim RVR/ASOS Interface. Proper calculation of the RVR product was confirmed with stand-alone RVR calculation software. Agreement between the transmitted ASOS ADU and the RVR product displayed on ASOS was confirmed for each transmitted product.

New Generation RVR VS measurements were manipulated with the aid of the calibration plate and foam plug. New Generation RVR ALS and RLIM measurements were manipulated by manually entering ALS and RLIM values via the MDT. Table 6 identifies the ambient light and runway light settings used as well as the expected RVR Controller Display (CD) reading and ASOS reading.

##### 4.4.2.3.1 Operational Procedure Test Part 2 Objectives.

The primary objective for part 2 of the Operational Procedure Test was to verify proper formation and transmission of ASOS ADUs from the Interim RVR/ASOS Interface after manipulation of RVR sensors. The test was also intended to confirm whether the transmitted ASOS ADU matched RVR products on all applicable ASOS display screens.

##### 4.4.2.3.2 Operational Procedure Test Part 2 Setup.

Test setup for Operational Procedure Test Part 2 remained as shown in figure 4.4.2.2.1-1.

TABLE 6. RVR PRODUCT GENERATION SETTINGS

ALS (ft-lamberts)	RLIM EDGE/CENTER SETTING	VS EXTINCTION COEFFICIENT ( $\text{km}^{-1}$ )	RVR PRODUCT (ft)	ASOS RVR
2000	0	w/ cal plate hi	100	100
2000	3	w/ cal plate lo	300	300
2000	5	As measured at field site	as computed	
2000	5	w/ cal plate lo	400	400
2000	5	w/ plug	6500	6500
2000	5	sensor fail	FFF	FFF
6000	0	w/ cal plate hi	100	100
6000	3	w/ cal plate lo	200	200
6000	5	As measured at field site	as computed	
6000	5	w/ cal plate lo	200	200
6000	5	w/ plug	6500	6500
6000	5	sensor fail	FFF	FFF
12000	0	w/ cal plate hi	100	100
12000	3	w/ cal plate lo	200	200
12000	5	As measured at field site	as computed	
12000	5	w/ cal plate lo	300	300
12000	5	w/ plug	6500	6500
12000	5	sensor fail	FFF	FFF

#### 4.4.3 Data Communication Failure Test.

The Data Communication Failure Test featured a simulation of various communication problems that could occur under operational conditions with the Interim RVR/ASOS Interface and ASOS. Simulated communication problems included erroneous block check codes, parity errors, baud rate conflicts, and cable disconnect. Interim RVR/ASOS Interface and ASOS performance were monitored during the existence of the communication problem as well as recovery from the communication problem.

##### 4.4.3.1 Data Communication Failure Test Objectives.

The Data Communication Failure Test objective was to determine whether the Interim RVR/ASOS Interface and ASOS can properly recover and handle communication errors that may occur during operation. This included detection and notification of communication problems as well as notification of the removal of a communication problem.

##### 4.4.3.2 Data Communication Failure Test Setup.

A PC-based Data Communication Fault Simulator (DCFS) was connected to ASOS as shown in figure 4.4.3.2-1.

#### 4.4.4 Extended Operation and Evaluation Test.

The Extended Operation and Evaluation Test consisted of configuring the New Generation RVR and ASOS to normal operating modes and allowing each system to function without operator intervention. Performance of the Interim RVR/ASOS Interface was then remotely monitored during naturally occurring weather conditions and maintenance for an extended period.

##### 4.4.4.1 Extended Operation and Evaluation Test Objectives.

The objective of the Extended Operation and Evaluation Test was to verify proper performance of the Interim RVR/ASOS Interface for an extended time period at an operational site.

##### 4.4.4.2 Extended Operation and Evaluation Test Setup.

Test setup remained as indicated in the Operational Procedure Test Part 2, however a protocol analyzer was not required, and as a result, not used.

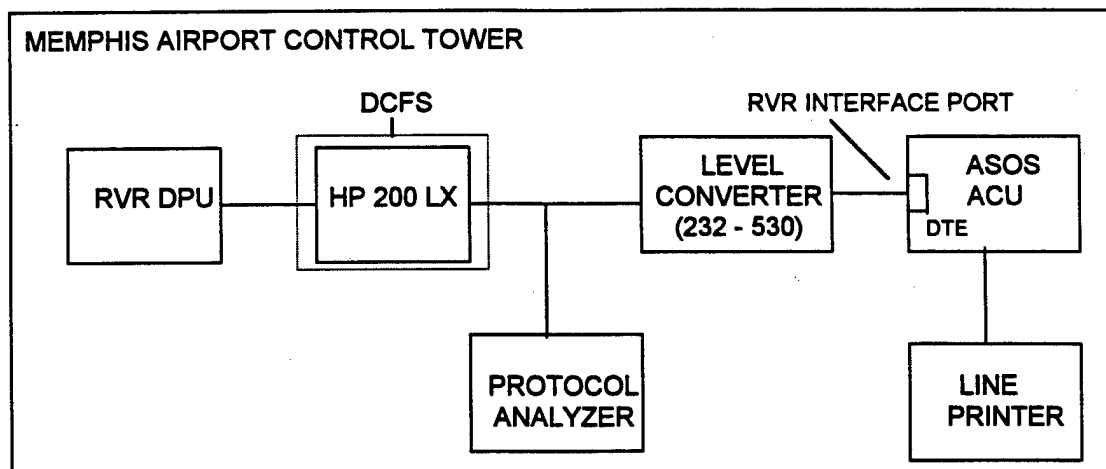


FIGURE 4.4.3.2-1. DATA COMMUNICATION FAILURE TEST SETUP

#### 4.5 DATA COLLECTION AND ANALYSIS METHODS.

For each test conducted data collection was accomplished through use of the following equipment and resources:

- a. Protocol analyzer;
- b. Test team observations--test conduct forms were used to record data from ASOS display screens and the RVR controller display;
- c. ASOS printer--to capture ASOS METAR reports and related display screens;
- d. DPU MDT--to capture relevant DPU parameters and screens during testing.

Data analysis consisted primarily of reviewing the protocol analyzer data capture files to ensure proper format and content of ASOS ADUs transmitted from the Interim RVR/ASOS Interface. This analysis was performed after test sessions at MEM were concluded. ASOS ADU transmissions displayed on the protocol analyzer were also monitored during test sessions as part of planned test sequences.

## 5. REGRESSION TEST #2 RESULTS.

Testing which began on September 29, 1997, included execution of all tests as specified in the New Generation RVR/ASOS Interface Test procedures dated September 26, 1997. The test period was concluded on October 13, 1997. The Interim RVR/ASOS Interface passed all tests conducted during the period. No discrepancies were observed during tests designed to verify proper performance of HP Palmtop RVR product calculations. Additionally, proper display of the HP Palmtop time stamp was noted during simulated communication problems between the New Generation RVR and HP Palmtop.

Despite passing regression tests, four Test Trouble Reports (TTRs) were generated in response to performance issues encountered during testing. Three TTRs related to operation of the ASOS. One TTR was documented for a problem observed on the HP Palmtop. Details of each problem are briefly discussed in the following paragraphs.

### 5.1 PROBLEM: HP PALMTOP OUTPUT RESPONSE TO NEW GENERATION RVR CONFIGURATION MODIFICATIONS.

After deconfiguring the New Generation RVR Visibility Sensor (VS) designated for Long-Line reporting, output from the HP Palmtop was monitored. The HP Palmtop software responded to the configuration change by transmitting FFF to ASOS for the RVR product assigned to the deconfigured sensor. According to the RVR-ASOS ICD (50-SANW-00050), a blank RVR product field i.e., " " should be transmitted in this scenario.

#### 5.1.1 Problem Impact.

This problem could result in situations where specifics concerning the status of the New Generation RVR VS or HP Palmtop are unclear without further maintenance activities. For example, as defined in the RVR-ASOS ICD, an FFF displayed on ASOS indicates the New Generation RVR Long-Line VS has failed or that maintenance is being performed. The current HP Palmtop software design would create an additional scenario for which FFF would be observed on ASOS.

#### 5.1.2 Recommendation.

The HP Palmtop software should be modified to transmit a blank RVR product as specified in the RVR-ASOS ICD.



## 5.2 PROBLEM: ASOS RVR SPECIAL.

During tests where a series of RVR products increased past the 2400-foot threshold, an ASOS RVR Special was expected but was not generated. For a series of RVR products decreasing through the 2400-foot threshold, an ASOS RVR Special was generated.

### 5.2.1 Operational Impact.

This problem could result in situations where it is unclear whether an ASOS RVR Special should be issued on the ASOS.

### 5.2.2 Recommendation.

ASOS operation regarding RVR Specials should be investigated and compared with the appropriate design specifications and requirements. An operational modification should be considered if a discrepancy exists between the operation of the ASOS and the required operation.

## 5.3 PROBLEM: LOSS OF RVR DATA AFTER ASOS RESET.

After performing a hardware reset on the ASOS ACU, several minutes of RVR data was observed to be erased from the "1-Minute Current Sensor Data" screen. The missing data was available on the "12 Hour Archive Data" screen.

### 5.3.1 Operational Impact.

Since the "1-Minute Current Sensor Data" screen contains 10 minutes of RVR data which is updated each minute, this problem should have a minimal, if any, impact on accessing RVR data on ASOS. The existence of current RVR data available on the "12 Hour Archive Data" supports this conclusion. However, since the "1-Minute Current Sensor Data" screen displays the "raw" or undecoded data from the RVR/ASOS Interface, this data could be lost under these circumstances.

### 5.3.2 Recommendation.

ASOS operation in this scenario should be analyzed with respect to design specifications and requirements. At a minimum, information regarding this performance aspect should be included with existing documentation regarding ASOS functions with RVR data. A design modification should be considered if a discrepancy exists between the ASOS operation and its requirements.

#### 5.4 PROBLEM: ASOS RVR STATUS SCREEN INCONSISTENCY.

When the RVR/ASOS Interface is not sending data to ASOS or when ASOS RVR processing is halted on the ASOS, the RVR status as indicated on the "1-Minute Current Sensor Data" screen displays RVR as "RVRNO", i.e., RVR Not Operational. This is inconsistent with how the ASOS handles processing for ASOS sensors when processing is halted. For example, when processing is halted for an ASOS sensor, the sensor status is indicated by an "M" on the "1-Minute Current Sensor Data" screen.

##### 5.4.1 Operational Impact.

This problem could result in additional delays in determining New Generation RVR or RVR/ASOS Interface status from the ASOS.

##### 5.4.2 Recommendation.

One of two courses of actions should be performed to account for this problem. [1] Provide additional documentation describing how the ASOS will display RVR status under the described scenario; [2] Modify how the ASOS displays RVR status to match the display of ASOS sensor status.

#### 6. FINAL RECOMMENDATIONS.

ACT-320 recommends deployment of the Interim RVR/ASOS Interface with software version 1.1. Sites containing previous software versions should be replaced with version 1.1.

Although the Interim RVR/ASOS Interface is suitable for use at Long-Line RVR sites, additional work should be performed on correcting problems identified during this and previous regression tests. If required, future software modifications should be transferred to existing Long-Line RVR sites after further regression testing.

#### 7. CONCLUSION.

Developmental test results conducted prior to regression testing and OT&E Regression Test #2 results indicate the RVR calculation and diagnostic time stamp problems have been corrected by modification to the HP Palmtop's RVR-ASOS processing software. The lack of significant performance problems encountered during testing suggests the Interim RVR/ASOS Interface is suitable for use at designated Long-Line RVR sites.

## 8. ACRONYMS.

AC	Alternating Current
ADU	Application Data Unit
ACU	Acquisition Control Unit
ALS	Ambient Light Sensor
ADU	Application Data Unit
ASOS	Automated Surface Observing System
BCC	Block Check Code
CAL	Calibration
CD	Controller Display
CWO	Contract Weather Observer
DCFS	Data Communication Fault Simulator
DOS	Disk Operating System
DCE	Data Communication Equipment
DTE	Data Terminal Equipment
DPU	Data Processing Unit
EIA	Electronics Industries Association
EU	External User
ETX	End of Text
FAA	Federal Aviation Administration
HP Palmtop	Hewlett Packard Palmtop PC
ICD	Interface Control Document
ID	Identification
LAX	Los Angeles International Airport
LCD	Liquid Crystal Display
MEATAR	Aviation Routine Weather Report
MB	Megabytes
MEM	Memphis International Airport
MDT	Maintenance Data Terminal
NDB+1	National Deployment Baseline version 1
NWS	National Weather Service
OID	Operator Information Display
OT&E	Operational Test and Evaluation
PC	Personal Computer
PCMCIA	Personal Computer Memory Card International Association
PPU	Product Processing Unit
PROD	Product
RAM	Random Access Memory
RLIM	Runway Light Intensity Monitor
RVR	Runway Visual Range
RWYID	Runway Identifier
SFO	San Francisco International Airport
SOH	Start Of Header
SIE	Sensor Interface Electronics
STX	Start of Text
VAC	Volts Alternating current
VS	Visibility Sensor

## APPENDIX A

<b>RVR/ASOS INTERFACE TEST TROUBLE REPORT</b>				TTR-R2-1	
DATE: 09/29/97		TIME:		SITE: MEMPHIS	
				STATUS: OPEN	
<b>SYSTEMS/COMPONENTS IN ISSUE:</b>					
RVR DPU	<input type="checkbox"/>	RVR MDT	<input type="checkbox"/>	ASOS ACU	<input type="checkbox"/>
RVR SIE	<input type="checkbox"/>	INTERIM INTERFACE	<input checked="" type="checkbox"/>	ASOS DISPLAY	<input type="checkbox"/>
RVR CD	<input type="checkbox"/>	FINAL INTERFACE	<input type="checkbox"/>	MPS	<input type="checkbox"/>
<b>TEST EQUIPMENT USED:</b>					
PROTOCOL ANALYZER <input checked="" type="checkbox"/>					
OTHER:					
<b>TEST PLAN ID:</b>					
TEST PROCEDURE ID: A.2			STEP(S): 78		
<b>DESCRIPTION OF ISSUE/PROBLEM: "HP PALMTOP OUTPUT DURING RVR</b>					
<b>CONFIGURATION MODIFICATIONS"</b>					
<p>After deconfiguring the New Generation RVR Visibility Sensor (VS) designated for Long-Line RVR reporting, output from the HP Palmtop was monitored. The HP Palmtop software responded to the configuration change by transmitting "FFF" to ASOS for the RVR product assigned to the deconfigured sensor. According to the RVR-ASOS Interface Control Document (50-SANW-00050), a blank RVR product field i.e., " " should be transmitted in this scenario.</p>					
NEW GENERATION RVR SOFTWARE VERSION ID: 4.1 (NDB + 1)					
ASOS SOFTWARE VERSION ID: 2.49					
INTERIM RVR/ASOS SOFTWARE ID: 1.1					
Michael Jones			09/29/97		
ISSUE/PROBLEM WITNESS			DATE		
Michael Jones			10/1/97		
FAA TEST DIRECTOR/REPRESENTATIVE			DATE		
NWS REPRESENTATIVE NSB			DATE		
Wendell Cook			10/01/97		
NOAA REPRESENTATIVE			DATE		

<b>RVR/ASOS INTERFACE TEST TROUBLE REPORT</b>				TTR-R2-2
DATE: 09/30/97	TIME: 0943 CDT	SITE: MEMPHIS	STATUS: OPEN	
<b>SYSTEMS/COMPONENTS IN ISSUE:</b>				
RVR DPU <input type="checkbox"/>	RVR MDT <input type="checkbox"/>	ASOS ACU <input checked="" type="checkbox"/>		
RVR SIE <input type="checkbox"/>	INTERIM INTERFACE <input type="checkbox"/>	ASOS DISPLAY <input type="checkbox"/>		
RVR CD <input type="checkbox"/>	FINAL INTERFACE <input type="checkbox"/>	MPS <input type="checkbox"/>		
<b>TEST EQUIPMENT USED:</b>				
PROTOCOL ANALYZER <input checked="" type="checkbox"/>				
OTHER:				
<b>TEST PLAN ID:</b>				
TEST PROCEDURE ID: A.1      STEP(S): 30 - 33				
<b>DESCRIPTION OF ISSUE/PROBLEM: "ASOS RVR SPECIALS"</b>				
<p>During tests where a series of RVR products increased past the 2400 ft. threshold, an ASOS RVR Special was expected but was not generated. For a series of RVR products decreasing through the 2400 ft. threshold, an ASOS RVR Special was generated.</p>				
<b>NEW GENERATION RVR SOFTWARE VERSION ID: 4.1 (NDB + 1)</b>				
<b>ASOS SOFTWARE VERSION ID: 2.49</b>				
<b>INTERIM RVR/ASOS SOFTWARE ID: 1.1</b>				
Michael Jones and Wendell Cook		09/30/97		
<i>ISSUE/PROBLEM WITNESS</i>		<i>DATE</i>		
Michael Jones		09/30/97		
<i>FAA TEST DIRECTOR/REPRESENTATIVE</i>		<i>DATE</i>		
<i>NWS REPRESENTATIVE (NSB)</i>		<i>DATE</i>		
Wendell Cook		09/30/97		
<i>NOAA REPRESENTATIVE</i>		<i>DATE</i>		

ASOS OID Printout follows:

16:15:04 01/21/97 2215Z

MEMPHIS INTERNATIONAL ARPT

UTC	VIS1	D/N1	VIS2	D/N2	VIS3	D/N3	WIND	DIR/SPD	5SEC	WIND	RVR
2149	0.050	D			0.050	D	186	11	187	13	23C60+
2150	0.050	D			0.052	D	186	12	181	14	23C60+
2151	0.050	D			0.052	D	186	12	188	12	36L60+
2152	0.050	D			0.050	D	185	10	181	10	36L60+
2153	0.050	D			0.050	D	184	10	176	11	36L60+
2154	0.050	D			0.050	D	186	10	188	10	36L60+
2155	0.050	D			0.050	D	187	10	190	10	36L60+
2156	0.050	D			0.050	D	186	9	187	10	36L60+
2157	0.050	D			0.050	D	183	9	180	10	36L60+
2158	0.050	D			0.050	D	182	9	193	9	36L60+
2159	0.050	D			0.050	D	184	8	181	9	M
2200	0.050	D			0.050	D	183	9	184	10	M

12 HR ARCHIVE

CC LOGGED ON AS TECHNICIAN FROM OID#4 ON 09/30/97 AT 07:05:57  
CC LOGGED OFF AS TECHNICIAN FROM OID#4 ON 09/30/97 AT 07:06:24  
WAC LOGGED ON AS TECHNICIAN FROM OID#1 ON 09/30/97 AT 07:23:01

09/30/97 07:35 \*ST 1406 RVR inoperational

09/30/97 07:51 \*ST 1407 RVR operational

ASOS OID Printout follows:

08:23:01 09/30/97 1423Z

MEMPHIS INTERNATIONAL AIRPORT

UTC	VIS1	D/N1	VIS2	D/N2	VIS3	D/N3	WIND	DIR/SPD	5SEC	WIND	RVR
1411	.102	D			.077	D	281	5	280	5	M
1412	.097	D			.073	D	283	4	287	5	02L02
1413	.089	D			.067	D	279	5	288	6	02L04
1414	.094	D			.076	D	315	6	311	8	02L06
1415	.090	D			.076	D	316	6	310	7	02L08
1416	.095	D			.074	D	295	5	292	7	02L12
1417	.098	D			.070	D	310	6	311	7	02L16
1418	.084	D			.069	D	298	6	295	7	02L20
1419	.077	D			.074	D	313	6	311	6	02L24
1420	.082	D			.068	D	309	7	307	9	02L28
1421	.077	D			.071	D	307	8	310	10	02L35
1422	.077	D			.074	D	298	8	296	11	02L45



<b>RVR/ASOS INTERFACE TEST TROUBLE REPORT</b>				TTR-R2-3
DATE: 09/30/97	TIME: 5:09 PM	SITE: MEMPHIS	STATUS: OPEN	
<b>SYSTEMS/COMPONENTS IN ISSUE:</b>				
RVR DPU <input type="checkbox"/>	RVR MDT <input type="checkbox"/>	ASOS ACU <input checked="" type="checkbox"/>		
RVR SIE <input type="checkbox"/>	INTERIM INTERFACE <input type="checkbox"/>	ASOS DISPLAY <input type="checkbox"/>		
RVR CD <input type="checkbox"/>	FINAL INTERFACE <input type="checkbox"/>	MPS <input type="checkbox"/>		
<b>TEST EQUIPMENT USED:</b>				
PROTOCOL ANALYZER <input checked="" type="checkbox"/>				
OTHER:				
<b>TEST PLAN ID:</b>				
TEST PROCEDURE ID: A.2      STEP(S): 65				
<b>DESCRIPTION OF ISSUE/PROBLEM: "LOSS OF RVR DATA AFTER ASOS RESET"</b>				
After performing hardware reset on the ASOS ACU, several minutes of RVR data was observed to be erased from the "1-Minute Current Sensor Data" screen. The missing data was still available on the "12 Hour Archive Data" screen.				
NEW GENERATION RVR SOFTWARE VERSION ID: 4.1 (NDB + 1)				
ASOS SOFTWARE VERSION ID: 2.49				
INTERIM RVR/ASOS SOFTWARE ID: 1.1				
Michael Jones and Wendell Cook		09/30/97		
<i>ISSUE/PROBLEM WITNESS</i>		<i>DATE</i>		
Michael McKinney and Michael Jones		09/30/97		
<i>FAA TEST DIRECTOR/REPRESENTATIVE</i>		<i>DATE</i>		
<i>NWS REPRESENTATIVE (NSB)</i>		<i>DATE</i>		
Wendell Cook		01/21/97		
<i>NOAA REPRESENTATIVE</i>		<i>DATE</i>		

<b>RVR/ASOS INTERFACE TEST TROUBLE REPORT</b>				TTR-R2-4	
DATE: 10/01/97		TIME: 8:45 AM		SITE: MEMPHIS	
STATUS: OPEN					
<b>SYSTEMS/COMPONENTS IN ISSUE:</b>					
RVR DPU	<input type="checkbox"/>	RVR MDT	<input type="checkbox"/>	ASOS ACU	<input type="checkbox"/>
RVR SIE	<input type="checkbox"/>	INTERIM INTERFACE	<input checked="" type="checkbox"/>	ASOS DISPLAY	<input checked="" type="checkbox"/>
RVR CD	<input type="checkbox"/>	FINAL INTERFACE	<input type="checkbox"/>	MPS	<input type="checkbox"/>
<b>TEST EQUIPMENT USED:</b>					
PROTOCOL ANALYZER <input checked="" type="checkbox"/>					
OTHER:					
<b>TEST PLAN ID:</b>					
<b>TEST PROCEDURE ID:</b>			<b>STEP(S):</b>		
<b>DESCRIPTION OF ISSUE/PROBLEM: "ASOS RVR STATUS SCREEN INCONSISTENCY"</b>					
<p>When the RVR/ASOS Interface is not sending data to ASOS or when ASOS RVR processing is halted on the ASOS, the RVR status as indicated on the "1-Minute Current Sensor Data" screen displays RVR as "RVRNO" i.e., RVR Not Operational. This is inconsistent with how the ASOS handles processing for ASOS sensors when processing is halted. For example, when processing is halted for an ASOS sensor, the sensor status is indicated by an "M" on the "1-Minute Current Sensor Data" screen.</p>					
NEW GENERATION RVR SOFTWARE VERSION ID: 4.1 (NDB + 1)					
ASOS SOFTWARE VERSION ID: 2.49					
INTERIM RVR/ASOS SOFTWARE ID: 1.1					
Michael McKinney			10/01/97		
<b>ISSUE/PROBLEM WITNESS</b>			<b>DATE</b>		
Michael McKinney			10/01/97		
<b>FAA TEST DIRECTOR/REPRESENTATIVE</b>			<b>DATE</b>		
<b>NWS REPRESENTATIVE (NSB)</b>			<b>DATE</b>		
Wendell Cook			01/21/97		
<b>NOAA REPRESENTATIVE</b>			<b>DATE</b>		